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1.	Your reference	HMJ03181GB 13 APR 1999
2.	Patent application number *(The Patent Office will fill in this part)*	**9908444.4**
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	RASMUSSEN, Ole-Bendt Sagenstrasse 12 CH 6318 Walchwil SWITZERLAND
	Patents ADP number *(if you know it)*	6056337003
	If the applicant is a corporate body, give the country/state of its incorporation	
4.	Title of the invention	Food product which artificially has been given a cell-like structure by coextrusion of several components, and method and apparatus for manufacturing such food product
5.	Name of your agent *(if you have one)*	GILL JENNINGS & EVERY
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Broadgate House 7 Eldon Street London EC2M 7LH
	Patents ADP number *(if you know it)*	745002

		Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number			

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7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application		

8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	NO

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Description	39
Claim(s)	15
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11. For the Applicant
Gill Jennings & Every

I/We request the grant of a patent on the basis of this application.

Signature

Date

13 April 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

JONES, Helen Marjorie Meredith
0171 377 1377

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08/04-99

Food product which artificially has been given a cell-like structure by coextrusion of several components, nd method and apparatus for manufacturing such food product.

The invention concerns a food product in sheet, ribbon or filament form consisting of at least two components which have been coextruded to become interspersed with each other and form a row-structure, and methods and apparatus for making such product.

In the term "food" product, I intend to include confectionary and medical products.

The inventor's two (expired) U.S. patents No. 4.115.502 and 4.436.568 disclose such products. The former discloses:

a) strands of a viscous sugar solution, interspersed with strands of dough; the coextruded sheet formed product is subsequently baked - and:

b) strands of highly viscous, dissolved or swollen protein and of a viscous sugar solution, caramel and/or dough; the coextruded sheet formed product is subsequently solidifed. (See col. 6 line 65 to col. 7 line 5 of this patent).

The other above mentioned patent contains an operative example for making a similar food product namely example 4. Here an alkalic solution of soya protein is intersepersedly coextruded with a solution of carboxy-methyl-cellulose to which is added caramel (for sweetening and aroma). To achieve a regular structure the two solutions have the same viscosity.

The coextruded sheet formed product is collected on a conveyor film of polyester (later to be used as wrap for the

product) and is solidifed by rinsing a solution of NaCl - lactic acid over it. This causes the protein to coagulat .

In each of the above mentioned examples each of the interspersed strands is a continous strand. In U.S. 4.436.568 this clearly appears from the text of the example when the latter is studied in conjunction with the drawing to which it refers. In U.S. 4.115.502 the only apparatus/method which is disclosed for interspersed coextrusion - see fig. 4 and connected description - will always produce continuous strands.

The food product according to the present invention is characterized as defined in claim 1.

Preferably the defined cellular structure extends generally throughout the product.

Compressional measurements of the resistance to deformation are commonly used in the food industry especially for the characterisation of gels.

The alternative possible types of "fluidity" or fragility for component A, all of practical importance, are specified in claims 2 to 7. It is immediately understandable that the invention provides a new concept for achieving a food product which on the whole has a solid and mechanically stable consistency and nevertheless is pleasantly chewable and in all respects makes a natural feel in the mouth, be it a substitute of meat, a filled chocolate, another type of confectionery, a snack, snack-masked medicine, or a completely new combination of food ingredients.

While A e.g. can be a continuous soft gel of plastic

character within each platelet or lump, it is essential that B also can be a continuous gel, but in this case a firm gel. As an example should be mentioned that a 0,3-1 % Ca-gel of pectin or carregenal gives the soft consistency used in jam, while a 5-10% gel of the same polymers gives consistency like articles of rubber and are suited as thin cell walls in the product of the invention. Today so firm gels are not industrially used. Later in this specification the possible compositions of A and B will be further clarified.

As it is understood from the above, B forms "cell-walls" and A the "cell-contents". Typically the biggest average dimension of the platelets or lumps is between about 1-30 mm, and the smallest dimension about 0,1-3 mm. Due to the characteristics of the extrusion process, the lumps or platelets are almost always of a curved shape, although exageration of such shape can and preferably should be avoided. The indication of the biggest dimension refers to measurements along the curved surface of the lump or platelet.

In the majority of the cells the thickness of the cell wall should preferably not at any place be smaller than 2% of the average thickness of the lump or platelet which is contained in the respective cell, since otherwise the mechanical stability may be insufficient. More preferably it should not be smaller than 5% and still more preferably 10% of the said average thickness.

On the other hand, to give the product a suitable consistency, the average wall thickness in the majority of the cells should preferably not exceed the average thickness

of the lump or plat let which is contained in the cell.

In most cases when A is fluid, the nesting of the platelets or lumps of A in B should preferably be a full encasement at least for the majority of the platelets or lumps. This is the more advantageous the more fluid A is.

The most advantageous rowformed cell structure is the composite filament formed structure with boundary cell-walls (at faces r and s, see fig. 1 a) and, branching off herefrom, bridging cells-walls, as stated in claim 11 and illustrated in the mentioned drawing. In this drawing there are shown two B-components B1 and B2 (and the reasons for using 2 B-components as shown will be given below) but the drawing must be understood so that B1 and B2 can be one and the same component. Dimensions of this filament structure are stated in connection with the description of the drawings ~~showing the process and apparatus~~ .

The coextrusion method for producing this structure may cause some attenuation of A as well as B at and close to the locations of branching, see fig. 3. By appropriate choises of the conditions during the extrusion such attenuations should preferably be limited so that the thicknesses of a branch and a boundary cell-wall both measured at the location of branching-off, should generally not be any smaller than 1/15 of the biggest thickness of the branch. More preferably not smaller than 1/10 and still more preferably not smaller than 1/5 of said biggest thickness.

Claims 13 and 14 state precautions to facilitate chewing of the food product and make it feel most natural in the mouth.

The effect of claim 13 can be achieved by addition to B of a substance which promotes the slip, e.g. a fat to a hydrophillic B-substance.

Contrarely there may be a need to strengthen the said bonding, and this can be achieved by the feature claimed in claim 15 (see also method claim 44).

Within the filament (separate filament or filament joined with other filaments) having boundary cell-walls of B, each platelet or lump of A may bridge the whole way between the boundary cell-walls at faces r and s. This is shown in fig. 1a and will in many cases give the best consistency of the product. However, the platelets or lumps of A can also be included in a less rational manner as shown in fig. 2.

The additional cell-wall stated in claims 17 and 18 serve to perfect the nesting of A in B, and are illustrated in fig. 1 b. As it appears from claim 1, A and B may in fact each comprise more than one component. A very advantageous example of B comprising 2 components B1 and B2 (joined adhesively with each other) is stated in claim 19 and illustrated in figures 1 a and 4 a and b. Thus B2 may e.g. be tougher than B1 (in the final state of the product) so that B1 easily is disrupted by the chewing to release the (tasty) A-component, while the consumption of B2 requires more chewing work - which is felt as a good combination. Furthermore when B2 is less deformable than B1 in the state it has during and immediately after the dividing in the coextrusion process, B2 helps to achieve the most regular cell structure.

This aspect is dealt with in connection w::th method claim 56.

Further specifications regarding the natu:e of components A and B are given in claims 20 to 35.

The short reinforcement fibres or platele:s in claim 23 are preformed, and are preferably but not nec:essarely digestible, e.g. short protein fibres. Th:y may contain absorbed aroma substances or the protein used for the fibres or platelets may have been brought to react with carbohydrate to form a caramel related compound.

The conditions for achieving the oriented structure claimed in claim 24 are mentioned in the descript:on connected with method claim 66. The orientation helps to make the product feel like meat when it is chewed.

The pulp of short protein fibres in A, mentioned in claim 27, has a similar purpose as the orientation in claim 24, and also purposes connected with the nutritional value.

When A is a sourmilk product as stated in claim 28, it can either be given sweetness and aromatic taste for use of the product as confectionery or desert, or be spiced like "chutney" for products used in a first course or main course.

The incorporation of air in the cells as stated in claim 33 is normally achieved by use of an expansion agent like the expansion of dough in breadmaking, or the expansion of vegetable protein with evaporating water in the conventional extrusion of meat substitute.

In the bread or cake products specified in claims 34 and 35, the B-component (c ll-walls) based on protein serves t

giv th product good mechanically stability even when the contents of the cells are very fragile (second grade flour or high contents of grain) or the product is very expanded. The use of cheese for the cell-walls as claimed in claim 35 is mechanically suitable and provides an interesting taste combination.

Claim 36 states the method of producing the product of the invention by coextrusion, with the components A and B being mutualyy interposed in parallel flows, and dieparts reciprocating or rotating to divide the flows and form segmental streams, and comprising the feature that B is modeled around A. There are basically two alternative ways of performing the reciprocation or rotation which divides the flows and forms segmental streams, one being the reciprocation or rotation specified in claim 37 and illustrated in figures 6 a and b and 10, the other being the reciprocation specified in claim 38 and illustrated in fig. 11 a and b. When the dividing is performed in the first mentioned way, there is primarely formed a "filament" structure, but several "filaments" can be joined to "ribbon" or sheet form as specified in claim 39.

This type of coextrusion belongs to a "family" for which the inventor in the past introduced the name 'lamellar extrusion". This signifies a coextrusion method by which two or more extrudable components first are interspersed with each other in a sheet-like array of flows which then are mechanically sheared out by means of transversely moved dieparts in a way that produces a sheet of thin lamellae - continous or discontinous - which are positioned at an ngle

to the main surfaces of the sheet.

To the knowledge of the inventor the only published inventions within this "family" are contained in French patent No. 1 573 188 issued to Dow Chemical Ltd., and those patented by the inventor of the present invention, comprising the two U.S. patents mentioned in the introduction to this specification (and counterparts in other countries), and further, referring to U.S. patent numbers, the following:

Numbers: 3,505,162, 3,511,742, 3,553,069, 3,565,744, 3,673,291, 3,677,873, 3,690,982, 3,788,923, 4,143,195, 4,294,638, 4,422,837, 4,465,724.

Only the two patents mentioned in the introduction to this specification disclose the use of lamellar extrusion for manufacture of food products, and as mentioned the components are not formed into segments according to these disclosures. The disclosures in the other patents are limited to synthetic polymers with a view to the manufacture of textiles or textile-like materials, and in a few cases reinforced board materials. The modelling of one component around segments of another component is not disclosed, neither is there disclosed any formation in these synthetic products of a cell structure comparable to the cell structure dealt with in the present invention.

For establishment of the cell structure according to the invention it is essential that the segments of B become modeled around the segments of A. One precaution for achieving this is specified in claim 40 and illustrated in

fig. 5. (An alternative or supplemental precaution is specified in claims 55 and 56, which will be dealt with later). Deciding in this connection, besides the geometrical form of the ~~partitions~~ dividing members and the extrusion velocity, are the resistances in each of the components against permanent deformation, and the tendency in each component to stick or slip from the surfaces of the ~~partitions~~ dividing members. A rheologist can easily adjust these different properties to achieve the wanted modeling without essentially affecting the physical/chemical properties or the taste of the components in the final product.+) Efficient ways of adjusting the resistance to permanent deformation in component A and to secure that A releases from the surfaces of the ~~partitions~~ chambers are described in connection with the explanations to claim 71. ++)

+) A similar expansion can be arranged for the other cross-sectional dimension of the segmental streams, which move between members (7).

At the state of dividing, A should preferably not be liquid, but can be plastic, pseudoplastic, gelformed, can be a dry powder or in other way a particulate material. In each case it means that, very generally speaking, a certain minimum value of shearforce is needed to cause permanent deformation under the conditions in the die.

B on the other hand (or B1 if there are two B-components in the arrangement shown in fig. 1 a and 4 a) should at this stage of the process be of a fluid to plastic consistency and generally exhibit a lower resistance to permanent deformation. It should preferably have plastic consistency in order to make the extruded product selfsupporting as it leaves the die.

The ways of interspersing the components with each other and to carry out the movements which cause the dividing of the

++) While precautions to model B around A are indispensable when a cell-like structure is wanted, such precautions can be omitted if the purpose is achievement of interesting visual effects in confectionery as specified in the independent claim 77 and in cl. 78.

members) are covered mainly by the part of B which is joined with A prior to the dividing, and the other two surfaces (which "bridge" over the segmental stream mainly with B from those internal orifices which carry B-component alone. This provides improved possibilities for controlling the thickness of the B layer in contact with the dividing member.

A modification of this embodiment of the method comprises the use of two B-components B1 and B2. It is specified in claim 56 and shown in principle in fig. 4 a, and with further details of the entire extrusion in fig. 10.

In connection with the description of product claim 19 there has already been discussion of the advantages of this modification, and it was mentioned that, provided B2 is less deformable than B1 in its state during and immediately after the dividing, B2 helps to achieve the most regular structure. This should be understood so: B1 should normally be easier to bring to flow than A, however if B1 = B2, the higher flowability will mean that the backpressure tends to squeeze B towards the walls of the dividing members, whereby the "boundary cellwalls" may become thicker than wanted, while the "bridging cellwalls" may become thinner than wanted. The use of B2 component which shows more resistance to flow than B1 can fully solve this problem. B2 can also, if wanted, have exactly the same composition as B1, but be fed into the extrusion apparatus at a lower temperature to give it higher resistance to deformation, e.g. it may be semifrozen.

It has already been mentioned that in many cases the nesting

of the segments of A in B is most advantageously a full encasement (as furthear specified in claim 17, claim 18 dealing with an optional cellular sub-structure of this). The method of the invention comprises two alternative embodiments (which can be combined) to achieve such structures, one being stated in claim 57, and illustrated in fig. 4 b and with further details in fig. 6 a and b, the other being stated in claims 58 and 59. The use of internal orifices which extend or are interrupted as dealt with here is known from the inventor's earlier patents on lamellar extrusion, but neither for the purpose of producing food products nor for production of any cellular structure comparable in geometri to the structures of this invention.

After the extrusion process, component or components B must be transformed to a firm cohesive form (optionally this transformation may already start before the dividing process) while component A may remain generally as it was during the dividing, or be transformed either to become more "fluid" or more fragile.
The alternative options for transformation of B (which may in some cases be combined) are stated in claims 60-70.

By cooling (claim 60), normally after melt-extrusion, examples: chocolate, swollen soya protein or gums. In some cases, when the process is sufficiently slow, e.g. consists in the formation of a gel, cooling of a fluid or plastic solution formed at a relatively high temperature e.g. about 100 degr. C can be carried out prior to the extrusion, which then can be established at normal ambi nt, or lower

temperature. Exampl s: adequately strong colloidal solutions of g latine, carragenal or Ca- or Mg-pectinat . Examples of solidification effected by heating of a colloidal solution (claim 62): adequately strong colloidal solutions of eggalbumin or gluten (or gluten-reinforced dough). Examples of reestablishment of the continuity in a previously disrupted gel (claim 63): a tixo-tropic colloidal solution of carragenal with addition of potasium ions (reestablishment on short times storage); heating/cooling of disrupted gels of casein or soya protein or starch.

Example of formation of a firm gel by a chemical reaction which is sufficiently slow to allow mixing of the reactants prior to the coextrusion (claim 65): Colloidal solutions of pectin or alginate in the methylated forms, with additions of Ca-ions and an enzyme which gradually demethylates the polymer, whereby the Ca-salt precipitates as a gel.

Examples of formation of a firm gel by chemical reaction between reactants in the B- and A-components (claim 66): As B component colloidal solutions of demethylated pectin or algine acid, as reactant in the A-component ions of Ca, Mg or Al. Coagulation by change of pH can also be used. As a precaution to fully secure that internal orifices are not blocked by such gel formation, the latter may be adapted in a way which requires a simultaneous change of pH and introduction of such metal ions. In such cases there is used two channel systems for component A, one to carry the said metal ions and introduce it into the B-"cellwalls" from one sid , and th other to change pH from the other side of the

B-"cellwall ".

Depending on d tails in the parameters of th extrusion process, a B-component in form of a colloidal solution will normally become molecularly oriented while it flows towards and through the internal orifices and proceeds along the walls of the dividing members. This orientation can be "frozen" if the gel formation by use of a reactant from the A-component is sufficiently fast. As already mentioned in connection with claim 24, the "frozen" orientation helps to make the product feel like meat when it is chewed.

Example of preformed solid particles which are coagulated to continous firm matter (claim 68): finedisperse particles of soyaprotein in a solution containing Ca-ions. The particles may be short fibres, in particular flat fibres which may be so short that they are platelets. For economical reasons flat fibres or platelets from expanded, oriented, fibrillated protein film is preferred. This is particularly useful for the B2-component in the structure shown in figs. 1 a and b, 4 a and b, as made by the apparatus shown in fig. ~~11~~ 10, but operating with the dividing members vibrating in "vertical" direction in addition to their "horizontal" reciprocations, by which the cutting of the fibres is facilitated. The protein from which the fibres are formed may have been brought to react with a carbohydrate at an elevated temperature to form caramel-related compounds, as already mentioned in connection with claim 23.

When there are two B-components B1 and B2, arranged as explained in the foregaoing, one method of giving B2 the wanted consistency before the dividing (cutting) process, is

to form B2 into a gel, at least in part, while it proceeds as narrow flows towards the dividing (cutting) process. This can in some case be done by admixing a reactant immediately before B reaches the channels for the narrow flows, and in some other cases by high frequency heating while B proceeds in the narrow flows towards the array of internal orifices.

Keeping in mind that A in the final product must be more flowable or more fragil than B, A may in some cases remain in the same generally plastic, gelformed or powderformed state which it had during the dividing and modelling processes, but in most cases it should either be transformed to a more flowable or more fragile form. More flowable especially when a juicy performance is wanted in the mouth when the "cellwalls" have been broken by chewing. More fragile if a crisp feel is preferable, e.g. small crisp lumps or platelets based on sugar or hard caramel and encapsulated in chocolate, or sintered grain or seed encapsulated in proteins.

When A has high contents of water, there are two ways of making A adequately semisolid to solid during the dividing (cutting) and modelling process steps, and later more flowable. One way is by freezing and later melting an adequate part of the water as stated in claim 71, another way is by use of depolymerization (hydrolyses) after the extrusion process, preferably by enzymes, as specified in claim 72 and 73.

When A is in frozen or preferably part-frozen state during the extrusion, freezing of B should normally be avoided, but

B should preferably prior to the extrusion be cooled down almost to it freezing point and the extrusion proc s should be carried out as fast as practically possible. The chambers for the narrow flows, and the row of dividing members should in such cases normally be made from metal and then kept at a temperature near the freezing point of B. Melting of a film from A during the passage through the die will normally be advantageous rather than harmfull provided the extrusion velocity is sufficiently high and this film therefore thin.

In order to keep the icrecrystals bonded together to an adequate plastic consistency, there should preferably be some amounts of sugar or a watersoluble polymer (e.g. partly depolymerized protein) mixed into the A-component, and dispersed short digestible fibres are also helpful in this connection.

If, contrarely to the aim of the above mentioned precautions there is aimed at fragility of A in the final product, to give a crisp feel in the mouth when it is chewed, this is best achieved by sintering of a powder as specified in claim 74.

When leaving the die the product will normally be supplied to a conveyor belt and may be cut into suitable pieces. The faces where it has been cut ("the wounds") may be sealed by conventional means. Optionally the entire piece may be enrob ed, e.g. in a thin film of chocolate.

If the transformation of B to a firm form is carried out by heat treatment, this treatment is best done while the product is on the conveyor belt, and can be by means of microwawes, high frequ ncy heating, contact-heating or by

hot air.

Dividing of the extruded continous product into longitudinal segments can be rationalized. E.g. the extrusion of A-component can be stopped during time intervals long enought to produce a transverse band of plain B components through which the product can be cut without making a "wound". Alternatively the extrusion of B can be interrupted during time intervals long enough to produce a transverse band of plein A-component, through which the continous product easily can be separated into longitudinal segments without any need to cut, and the "wound" can then be washed clean of A component (which can be recycled).

Such precautions are normally unnecessary if A in the final form is firm or semifirm (e.g. marzipan or a fruit paste encapsulated in chocolate) since in this case simple cutting may be fully satisfactory.

The invention will now be explained in further detail with reference to the drawings.

Fig. 1 a and b show in "horizontal" and "vertical" sections, respectively, the structure according to an embodiment of the invention with A as "cell contents" and B1 and B2 as "cellwalls".

Fig. 2 shows, in "horizontal" section, an A/B "cell structure" according to another embodiment of the invention.

Fig. 3 shows, in "horizontal" section, a type of A/B-structure which preferably should be avoided, except in special cases.

Fig. 4 a and b show, in "horizontal" and "vertical" sections respectively, and on broad principle, the modelling of B-components around the A-component, by forming conjugent B1-A-B1 and B1-B2-B1 flows and dividing and joining these flows to segmental streams.

Fig. 5 shows an alternative way of modeling component B around the segment of A, namely by rheological means.

Fif. 6 a and b show, in "horizontal" and "vertical" sections respectively, a segment from beginning to end of a flat coextrusion die for making the sheet-formed food product shown in fig. 1, however working with only one B-component, i.e. B1 = B2.

Fig. 7 a and b are illustrations in connection with the explanation of the coordination of the dividing reciprocations and the pulsations in the flows of A and B, fig. 7 a being a detail from fig. 6 a, showing 3 different positions of the dividing members, and fig. 7 b being a graphic representation of the reciprocation, which is not harmonious.

Fig. 8 a and b show, in "horizontal" and "vertical" sections respectively, the detail indicated on fig. 6 a, namely a stamplike device which extends into a narrow channel and has surface grooves like a file, and the corresponding surface of the channel, also with grooves like a file.

Fig. 9 shows a modification of the apparatus shown in fig. 6 a and b, namely a modification in the array of internal

orifices and row of dividing members, to cut the flows into segments by scissors action.

Fig. 10 shows, in 'horizontal" view and in full width for production of a ribbon formed product, a modification of the apparatus shown in fig. 6 a and b, namely for production of the product of fig. 1 a and b with two different B components B1 and B2. With a small change, the same apparatus can be used to produce a product with two A-components and one B-component.

Fig. 11 a and b show, in "horizontal" and "vertical" sections respectively, a flat coextrusion die according to the invention which is basically different from that shown in fig. 6 a and b, constructed to divide the flows by generally "vertical" instead of "horizontal" reciprocations.

The typical cell-like structures of the invention, shown in figures 1 a and b and 2, are first formed as segmental "filament" structures, and several such "filaments" are then joined to "ribbon" or "sheet" form. The dotted lines (1) indicate the borders between the filaments, where the bond may be so weak that the filaments easily separate from each other in the mouth, which usually is advantageous, but the B-material from two neighbour filaments may also be so intimately connected that the borderline only with difficulty can be found in the product.
The faces r, s, t and u of each filament, referred to in some of the claims, are indictaed by arrows.
If B1 is identical with B2, these structures can be made

with the coextrusion die shown in fig. 6 a and b, and if B1 is different from B2 - for reasons which have be n explained in the forgoing - they can be made with the die shown in fig. 10. It depends on the rheological properties of the components and the relative dimensions in the array of internal orifices (6) and the row of dividing members (7) whether the structure shown in fig. 1 a and b or that shown in fig. 2 will be formed.

Typical dimensions within each of the filaments in the structure are:

from face r to face s: 1-20 mm

from face t to face u: 1-50 mm.

If the distance from t to u exceeds about 8-10 mm there should preferably be established a subdivision of the cell structure by one or several "horizontal" cell-walls like (2) in fig. 1 b.

Fig. 1 a shows the segments of A having a curved form (with the cell-walls of B1 and B2 fitting to this), and fig. 2 shows the segments of A "pointing" in one direction, which in fact has been the direction of extrusion. Such shapes or "deformations" of the structure are normally not intended but almost unavoidable due to the friction while the segmental stream passes between the dividing members (7) (and show that the product is a coextruded product). However, if such deformations are exagerated as shown in fig. 3, they may be harmfull. This can happen by inadequate choise of rheology for one or both of the components and/or insufficient modelling of B around the segments of A. Claim 12 states preferabl limits for th "deformations" in the

B-structure. The r fer nc to thicknesses in this claim i illustrated in fig. 3 as follows:

the smallest local thickness of a branch in the vicinity of the branching-off is shown with arrows (3), the smallest thickness of the boundary cell-wall in the same vicinity by arrows (4), and the biggest thickness of the B-branch by arrows (5).

The biggest thickness of the branch is defined as follows: from a point of the convex surface, the distance to each point on the concave surface is measured, and the smallest distance so found is registered. This is repeated for every point on the convex surface. The (indefinitely many) registered minimum values are compared, and the biggest one so found is the maximum thickness of the branch.

It should be noted that there are cases especially within the confectionery industry where the protecting effect of B is unessential, while there can be advantageous estetical values of the patterns of different segments, when the components have different colours or are dark/white, and not least an "abstract" pattern like that of fig. 3 can be interesting. In such cases the product is preferably cleaved (cut) "horizontally" to expose the segmental structure best possible. In these very special cases, the modelling of B around A can be omitted, so that there will not be formed any boundary cell-walls of B, but each segment may become "indefinitely" attenuated at the boundaries r and s.

Examples: dark chocolate/white chocolate, dark chocolate/marzipan, white chocolate/caramel, two differently coloured gums.

In fig. 4 a and b, composite (conjugent) flows B1-A-B1 and

B1-B2-B1 are extruded through the array of internal orifices d fined by the or::fice elements (6). Th formation of these composite (conjugınt) flows is shown in figures 6 a and b and in fig. 10. Both composite flows are divided by shear between the recip::ocating (arrows 9) diepart which comprises the orifice elements (6) and the stationary dividing members (7).

The different segmental streams are merged to "ribbon" or "sheet" form at the edgeformed ends (8) of the dividing members.

In order to achieve well-ordered segmental streams between the dividing members (7) as shown, the reciprocation is (almost) stopped while the spaces between the dividing elements (7) match a set of internal orifices (defined by 6) either for the B1-A-B2 or for the B1-B2-B1 flow, and a piece of the respective composite flow is then injected in pulses. The coordination between the reciprocations and the pulsations shall be explained in more detail later, especially in connection with fig. 7 a and b.

As it appears from fig. 4, this combination between a formation of composite flows ("conjugent spinning") and dividing/joining segments leads to the result that components B1 and B2, taken together as "the B-component" will surround and "nest" each segment of A at least in two dimensions.

The drawings must also be understood to illustrate an arrangement as claimed in claim 55, in which there is only one B-component, i.e. instead of the composite B1-B2-B1

flows there is injected pl in B1-flows, wh:le there still is interposed conjugent B1-A-B1 flow: therebetw en.

The advantages of using two instead of one B-component, and in the here described manner, have been explained in the foregoing.

An alternative way of modelling B around the segments of A is as claimed in claim 40 and shall now be described with reference to fig. 5. This is a simpler method in which there need not be formed composite flows prior to the dividing and in which there neither is any need to carry out feeding of the components in pulsation (if the rheology allows use of ordinary extrusion means), nor to adjust the division in the array of internal orifices defined by (6) and the division in the row of dividing members (7) to match each other.

However, weighing against the use of this simplified method is the fact that it provides less possibility to control the eveness of the structure and reduce the thickness of the cell-walls of B-component.

The drawing shows the moment when an internal orifice for A defined by elements (6) matches with an opening defined by members (7), i.e. just before cutting of a segment of A. A has begun to follow the surfaces of (7). However, the channel defined by these surfaces widens, and when B flows easier than A and/or A shows a lower tendency to sticking, A will slip away from the surfaces of (7) and become surrounded by B.

The mechanically operated flat coextrusion die shown in figur 6 a and b, consists of a stationary inl t part (10).

a reciprocating "interpositioning part" with chambers for the interposed narrow flows defined by walls (11) and ending in the array of internal orifices defined by elements (6) and a fixed exit part supplied with dividing members (7). The reciprocation is indicated with the arrows (9). The apparatus is normally installed in such way that the section shown in fig. 6 a is really horizontal or relatively close to horizontal. The two components A (for "cell-contents") and B (for "cell-walls") are fed through the inlet part (10) through two relatively long and narrow channels (indicated by "A" and "B") by conventional feeding means, i.e. by pumping, extrusion or simply by gravity, the latter optionally in connection with vibration. The devices for such actions are not shown. The inlet part (10) is outside the section shown in fig. 6 a, but the position of the walls for the A-chamber and the B-chamber in this part are indicated by the dotted lines (12) and (13), respectively.

In the reciprocating "interpositioning" part there is a number of narrow channels for A and B defined by walls (11)+ The drawing only shows one for A (indicated by A) and two ~~for B (indicated by B) but it should be understood that~~ there normally are many for each of the components. These channels are closed channels, except at their exit end and except for an opening in each channel towards the corresponding channel in the fixed inlet part (10). Thus, since fig. 6 b shows a section which goes through one of the A-channels in the reciprocating part, it shows this channel opening towards the A-channel in feed-part (10), while it

+) in housing (11a)

doe not open towards the B-channel in the feed-part.

Oppositely t the exit, each channel in the reciprocating interpositioning part is closed by a vibrating stamp (24 or 25) moved through a transmission rod (26). The construction and function is further described below.

At the exit of the reciprocating part with walls (11) each flow of B is divided to three part-flows, one which joins with one neighbour A-flow, another which joins with the other neighbour A-flow, (so that each A-flow becomes a conjugent B-A-B-flow before it leaves the reciprocating part through an internal exit orifice) and a third which remains a plain B-flow until it has passed out through its internal orifice.

In addition to the joining of A and B to conjugent flows which just has been described, each flow of A is divided horizontally (seen in relation to the sheet-plane) through its middle by means of the double-wedge (16) which is integral with the respective walls (11), and the B-component will interpose between the two half-parts. The part of the double wedge which points towards the exit, in fig. 6 b shown by dotted lines, helps to drive B in between the two half-parts of the A-flow. In analogous way, the protrusions (17) from the upper and lower walls of each A-channel serve to interpose B between these walls and A.

In the stationary exit part, with dividing members (7) and collection chamber (18), each member is sharp-edged at the side which is adjacent to the reciprocating part, and therefore the B-A-B flows are divided by cutting, one edge

of ach member cutting when the movement is one way, and the other edge cutting when it is the other way. The flows of plain B-component will also be cut or will become sheared out, and will predominantly interpose between the cut-faces of the B-A-B segments.

Each member (7) is prismatic, also ending in a sharp edge, and the streams of A-segments encased in B join to a sheet when they pass these edges. The surfaces along which the material flows are preferably curved as shown, while the 3rd surface is plane to pack against the exit of the reciprocating internal orifices defined by (6).

When leaving the stationary exit part, the cellular food product is taken by a conveyor belt (19) e.g. a steel or nylon belt which moves over a roller (20). The other side of the exit from the die is formed by a flexible band (21) (e.g. rubber or steel) fixed to the housing for the dividing members (6). An adjustable bar (22) determines the gab of the exit orifice. (Means for adjusment are not shown). In fig. 6 a the position of the edge of the band (21), which is the very end of the coextrusion die, is indicated by the dotted line (23). If the gab at the exit is too narrow the cellular structure will become more or less disturbed, and if it is too wide the individual segmental flows may not join to a sheet.

When the solidification of B takes place by thermal or chemical coagulation, an essential part of this process should preferably, as already mentioned be carried out while the product is on the conveyor belt.

D vices to optionally divide the product lengthwis and/or

sid wise to pieces of a convenient ize, a d devices to s al the cut-f ces of these pieces, re conventional and not shown.

The division in the row of members (7) in the exit part should preferably exactly equal the distance from middle to middle of the A-channels (or the B-channels) in the reciprocating part. Furthermore the reciprocation is preferably adjusted so that, in each position where it changes direction from "left" to "right", or from "right" to "left" there is opening for passage of the B-A-B flow, and further so that the B-A-B flow which supplies while the exit part is in position "left", is immediate neighbour to the B-A-B flow which supplies while the exit part is in position "right".

In other words the stroke from "left" to "right" corresponds approximately to one division, (however the stroke should preferably be slightly longer). These features are further explained below in connection with figures 7 a and b. The mechanical means for reciprocation are conventional and are not shown in the drawing.

The extrusion of components A and B towards the exit of the die is established by a combination of the conventional forwarding through the feed-part (9) and vibration of the stamps (24) or stamplike devices (25) through the transmission rods (26). All transmission rods for movement of A are mutually connected to synchronize the actions, and similarly for those which move the B-component.

The shape of the stamps 24 appears from fig. 6 b. The

oblique and serrated form of the front (27) serves in the best way to change the direction of flows from vertical to horizontal, and the knifeformed "nose" (28) helps to reduce the resistance against the entrance of the flow into the narrow chamber.

The vibration of the stamps or stamplike devices for A are synchronized with the reciprocations of the interpositioning part in such a way that the velocity of pushing forward is at its maximum at the "left" and at the "right" turnpoint of the reciprocation whereby the frequency of these A-vibrations is double that of the above mentioned reciprocations.

The B-vibrations are synchronized with the reciprocations in such a way that there are 4 maxima of push during one period of reciprocation, namely:

1) when the reciprocating part is in position "right",

2) when it is in the middle position,

3) when it is in position "left" and

4) when on return towards "right" it again is in the middle position. In other words, the frequency of the B-vibrations ~~is 4 times that of the reciprocation.~~

These synchronizations are better understood with reference to figures 7 a and b. Corresponding to position "right" of the reciprocating part, two neighbour members (7) of the exit part are drawn with full lines. Corresponding to position "left" the same two members are drawn with thick dotted lines, and corresponding to the middle position they are drawn with thin dotted lines. (In order not to make the drawing too complicated, it is shown as if "the

interpositioning part" were fixed and th exit part moving). In the row of internal orifices in the (really) reciprocating part the orifices for the composite B-A-B flow is marked B-A-B and the shown orifice for plein B is marked B.

As already mentioned and as it appears from the drawing, the division in the row of dividing members (7) equals the distance from middle to middle of the internal B-A-B orifices, while the length of the stroke is somewhat bigger. In each of the positions "right" and "left" there is full passage for the B-A-B flow while there is closed for the plein B flow, and it is oppositely in the middle position. Therefore, following a cut by a sharp edge through the B-A-B flow, the cut-phase will be covered with material extruded through an orifice for plein B-component, and this component will be sheared out over the entire cut-phase. In order to match this opening and closing best possible, the rythms of the A-stamps and the B-stamps should be as stated above, and furthermore the reciprocation of the "interpositioning part" should preferably not be a simple harmonous reciprocation, but should slow down or even become zero around the middle position. This is illustrated in the graph fig. 7 b where "t" shows time and "a" amplitude, and it is seen that the velocity is zero not only at the "right" and "left" positions I) and II), but also in the middle position II).

While the frequencies of the A- and B-vibrations follow the reciprocations as explained, the amplitudes of these vibrations are independantly adjustable. It may even be

arranged so th t the push on B in the middle position can be adjusted independantly of the push on the same component in positions "right' and "left".

Since the components often must have very different temperatures while they become divided and joined and therefore often must be fed into the coextrusion die at very different temperatures, A e.g. deepfrozen and B e.g. between 0-10 degr. C, the different feed-channels in the inlet part (10) should normally be heat insulated from each other, while the reciprocating "interpositioning part" with walls (11) and elements (6) should be made of metal and temperature controlled (e.g. at a temperature near 0 degr. C, so that freezing of B is avoided and melting of A is minimized). The fixed exit part with dividing members (7) is also preferably made of metal and temperature controlled, usually at a somewhat higher temperature in order to reduce the friction of B against the walls of (7).

Between the mutually reciprocating dieparts (10 against 11 and 6 against 7) there is used conventional sealing arrangements e.g. with use of teflon-bronze. These arrangements, and the bearings etc. which hold the reciprocating part in position are not shown in the drawings.

The food product extruded out of the die will most practically be from about 1-10 cm wide, but in order to achieve a suitable production capacity per die, the latter should preferably be much wider, e.g. between about 50-100 cm wide. Therefore the joining of the "segmental filaments" can be interrupted at intervals along the width by making

th respectiv ends of the dividing members (7) flat inst ad of letting it end in harp edg .

Contacting and above the conveyor belt (19) there may be narrow belts to prevent the extruded product to collaps and flow out sideways, if it is not selfsupporting at this stage.

Normal dimensions of each "filament formed" segmental stream have been stated in connection with the description of fig. 1 a and b and fig. 2. The dimensions at the end of the die are generally similar, and as it appears from fig. 6 a, the division in the array of internal orifices (6) is the same <u>when</u> there is counted from the middle of a B-A-B orifice to the middle of the next B-A-B orifice or from the middle of a B orifice to the middle of the next B orifice.

As the more detailed drawings (fig. 8 a and b) of the stamplike device (25) shows, the extruded material A or B is first pushed by the oblique and serrated front (27) on each stamp (25) and the driving movement is then taken over by the array of asymmetrical grooves (29) on the thin bar (30) which is positioned in the respective channel and extends over almost the full depth of the latter. When (30) moves backward, the asymmetric grooves (31) on the opposite channel wall almost prevents the flow from following bar (30) backward.

This extrusion system which seems to work by dragging rather than pushing, has been found very efficient when the material to be extruded exhibits a high cohesive force under dragging f rces and when simultanously the tendency to stick

t the grooved surfaces is low (can be reg lated by substances acting as slip- gents) E.g. it s particularly well suited for extrusion of components wi h short fibres dispersed, which normally tend to block na row channels. On the other hand it is not applicable to ext usion of materials of low cohesive strength under d agging forces, especially not when they tend to stick.

Instead of the arrangement of grooved surf ces shown in these drawings, in which one surface of th bar and of the chamber are without grooves, and these two surfaces are in contact, there can be asymmetrical groo es on both surfaces of the bar (30) which then is pos tioned in the middle of the channel, and on both surface of the channel.

Another and very advantageous arrangement s two bars working in "push-pull" with asymmetrical g ooves on the mutually confronting surfaces, while there are no grooves on the channel walls.

The asymmentrical grooves can be substitut d by protruding asymmetrical serrations. This is in partic lar advantageous for extrusion of materials with contents o fibres. The latter become "micro-carded".

The stamps are preferably cast from a synt etic polymer, e.g. nylon 6. Their movements can e.g. be rranged by means of wheels with tracks. The transmissions b tween this guiding arrangement and the stamps should e flexible to allow the reciprocations of the chambers.

In the modification shown in fig. 9, the c annel shape in and close to the exit orifices defined by 6) is bent, and th lements (6) end in sharp edges (32) which together with

the harp edges on the dividing members (7) perform scissors action.

In the modification shown in fig. 10, there is prior to the dividing, formed conjugent flows B1-B2-B1 and B1-A-B1. The result is the structure shown in fig. 1 a and b or fig. 2, and as further explained in connection with fig. 4 a and b.

With a simple modification this die can also be used to make cell-like structures with two A-components A1 and A2 and one B-component, in which A1 and A2 are individually surrounded by B. In this case A1 is extruded through the channels marked A, A2 through the channels morked B2 and B1 through the channels marked B. In this case there must in each of the elements (6) be an orifice for extrusion of plein B-component, and the reciprocation must be adapted (almost) to stop when these orifices for plein B match openings between the members (7).

In the basically different embodiment of the invention shown in figs. 11 a and b the cutting is by means of almost vertical reciprocation (seen in relation to the sheet plane) and the reciprocating member is the exit part (33) which swings as indicated by the double arrow (34) around axis (35), positioned immediately over the conveyor belt (19). By conventionally means, not shown, A and B are fed into three parallel wide chambers (36, 37 and 38) as indicated by the arrows marked A and B. A is further pushed by the stamp (39). Contrary to the stamps shown in figures 6a and b this is one stamp covering the full width of chamber (37).

At the exit of the "internal die" for component A, defined by walls (40) and (41), there is a row of double-wedge formed dividing members (42), of which only two are shown. They are constructed and work in similar way as (16) in figures 6a and b. And at each side where the "internal die" for A ends there is a protrusion (43) similar to (17) in these two figures. By means of dividing members (42) and the two protrusions (43) the sheet-formed flow of A is divided into individual, filament formed flows which each become fully surrounded by B when the sheet formed flows of B merge with A from both sides. This composite sheet structure is then chopped into segments during each of the movements up and down of the exit part (33) by means of each of its sharp edges (44 and 45). Around the highest and the lowest position of these edges there will only pass B component into the exit part, and therefore B will become smeared out over the cut-faces of A. Thus each segment of A will become fully "wrapped up" in B.

The reciprocation of (33) is not simple harmonious, but goes down to about zero velocity in the middle position. See again fig. 7b.

In the foregoing, the description of how extrusion of component A takes place is focused on the use of "stamping" action, either

a) as in fig. 11b stamp which fits to the full width of a chamber in an extrusion die, near its exit or

b) as in figures 6a and b with many small stamping devices arranged side-by-side so that they together end in an array (linear or circular) of chambers near the exit of the die,

interposed between channels for one or more other extrudable components.

However, it should be noted that the propelling, also of component A, in many cases can be carried out by means of conventional pumping/extrusion means without any use of stamping action.

On the other hand, the use of such stamping devices, either with one stamp in full chamber width, or in form of many small devices arranged side-by-side in an extrusion die (flat or circular) and ending in an array of channels, with or without channels interposed therebetween in the array, is useful also for several other purposes - coextrusion or monoextrusion - and in itself is a new invention.

Examples of different kinds of products according to the invention.

I): Confectionery.

1) A: powdered hard caramel and/or finely divided nuts, "sintered" in the extrusion process.

B: chocolate, semimolten during the extrusion process.

2) A: Marzipan, or sweet fruit-mass thickened with soluble protein

B: see I) 1)

3) A: Icecream, e.g. chocolate icrecream, or sweetened frozen youghurt, melted after the extrusion process.

B: A firm gel of pectin, in disrupted disperse state during the extrusion process and subsequently regenerated by heating and cooling.

When A is based on chocolate icecream with vegetable fat

instead of milk fat, 3) can be a suitable substitute of chocolate bars made without use of fatty acids.

II) "Hybrids" between confectionery and protein foodstuffs.

1) A: cheese extruded in plasticized state.

B: see I) 1)

2) A: see I) 1)

B: a disrupted firm gel of soyaprotein or cassin, regenerated by heating and cooling.

III) Meat-like foodstuff on basis of vegetable protein.

1) A: a strong soup, or youghurt with herbs and spices ("cutney"), with addition of small amounts of a thickening agent; in frozen doughlike state during the extrusion process.

B: see II) 2).

2) A: during the extrusion: soya flour dispersed in water thickened by means of part-hydrolized soyaprotein, and with spices and other aromatic substances, plus proteinase added - after the extrusion: hydrolized by the proteinase.

B: See I) 3).

IV) Cellular products with contents like sausages.

A: a paste as normally used in sausages, optionally with addition of part-hydrolized soyaprotein as a thickening agent.

B: see II) 2), or I) 3) or a firm starch gel, disrupted before the extrusion and regenerated by heating/cooling.

This is e.g. a new and advantageous way of using 2nd grade

products from the slaugteries.

V) Bread- or cak -like products.

A: Conventional dough with expansion aid.

B: See II) 2)

The product is baked, whereby the cell structure helps to obtain a fine and even expansion.

Operative examples.

In the following 3 examples, the coextrusion die was a laboratory machine constructed according to the principles shown in fig. 6a and b and heated/cooled by circulating water, the temperature of the die itself kept under control. The division in the row of dividing members (7) was 10 mm and the depth of the channels between (7) 1.5 mm, the cross-sectional dimensions of the "filaments" in the final product therefore 10 mm (horizontal) x 15 mm (vertical). The feeding of A and B into the die took place by simple ram extrusion. The product coming out of the die was taken up on a teflon coated tray, which was manually moved.

Example 1.

Cell contents (A): marzipan.

Cell-walls (B): chocolate

Proportion between the components: A/B = 3 : 1.

The chocolate was fed to the die at temperature 30 degr. C and the marzipan at 10 degr. C.

The optimum temperature of the die itself, which depends on the quality of the chocolate, was determined by trial and error.

<u>Example 2.</u>

Cell contents (A): expanded, baked wheat-dough.

Cell-walls (B): cheese

Proportion between the components: A/B = 2 : 1.

The cheese was fed to the die in dry powdered form (Parmessan).

The dough contained bakingpowder.

Themperature of the extruded components and of the die was 20 degr. C.

The extruded product taken up on the tray was supported by teflon coated lists at the sides to prevent it from floating out during baking, and was then baked. After baking and cooling it was found that the cheese formed continous cell-walls.

<u>Example 3.</u>

Cell contents (A): honey.

Cell-walls (B): a firm pectin gel, precipitated by chemical reaction.

Proportion between the components: A/B = 5 : 1.

B is fed in form of a viscous 5% solution in water of low-methoxy pectin of temperature 2 degr. C.

A is a honey which is in plastic state at room temperature and to which is added Ca-lactate in an amount double that which is equivalent to the pectin with which it shall react.

A is fed at temperature -15 degr. C, and the die temperature is controlled at +2 degr. C.

The extruded product is cured by storage at room temperature, and it is found that B forms firm continous cell-walls.

CLAIMS

1. A food product in sheet, ribbon or filament form consisting of at least two components which have been coextruded to become interspersed with each other and form a row structure, <u>characterized in that</u> this row structure is a cellular structure in which one or more components (A) have the shape of discrete platelets or lumps nested according to at least two dimensions in one or more components (B) which as cell walls define cell like spaces comprising said platelets or lumps and which is/are in firm cohesive form in the final state of the product at ambient temperature to form a continous matrix for A, and at least make the product selfsupporting at such temperature, and either A being weaker than B at least by a factor of 2 with respect to permanent deformation in form of flow or fracture when tested under compressional forces at the ambient temperature, such tests referring to the compact A and B materials in the physical state they have in the product, or the cell-like spaces being expanded to at least 50% contents of air.

2. A product according to claim 1, <u>characterized in that</u> A in the final form of the product at ambient temperature is in liquid state.

3. A product according to claim 1, <u>characterized in that</u> A in the final form of the product at ambient temperature is in a plastic state.

4. A product according to claim 3, <u>characterized in that</u> each platelet or lump at ambient temperature is a continous soft gel of plastic character.

5. A product according to claim 3, <u>characterized in that</u> ach platel t or lump of A is a pulp, .g. of short fibr s

or platelets dispersed in water.

6. A product according to claim 1, characterized in that each platelet or lump of A is in powdered state with air filling the space between the individual particles of the powder.

7. A product according to claim 1, characterized in that each platelet or lump of A is a fragile agglomerate of smaller particles.

8. A product according to claim 1, characterized in that B is a continous firm gel.

9. A product according to claim 1, characterized in that at least the majority of platelets or lumps of A are fully encased in B.

10. A product according to claim 1, characterized in that the average thickness of the cell walls of B is generally the same as or smaller than the dimension of the lumps or platelets, the latter also taken as an average.

11. A product according to claim 1, characterized in that it consists of a discrete or several mutually bonded composite filaments having a generally rectangular or parallellogram formed cross section whereby two of the generally parallel filament faces (r and s) each consist of a boundary cell wall B-component, and between these two boundary cell walls there are bridging cells walls of B-component branching off from the boundary cell walls to form cell like spaces in which A is nested, and if the product comprises several such filaments the latter are joined with face r in one filament adhered to face s in an adjacent filament.

12. A product according to claim 11, characterized in that

if s id bridging cell walls are attenuated [redacted] in th vicinity of the locations of branching, the local thickness of a branch and a boundary cell wall, both measured [redacted] in the vicinity of the location of branching off, are generally not any smaller than 1/15 of the biggest thickness of said branch.

13. A product according to claim 11, characterized in that said adhesion is weaker than the cohesion within the said strands of B-component.

14. A product according to claim 11, characterized in that the said boundary cell walls of B-component are attenuated or interrupted at intervals with spaces of air or A-material between such interruptions, to facilitate chewing of the product.

15. A product according to claim 11, characterized in that the said boundary cell walls of B-component extend in waived or zig-zagging manner.

16. A product according to claim 11, characterized in that each platelet or lump of A bridges from one to the other of said boundary strands of B.

17. A product according to claim 11, characterized in that the other mutually opposite faces (t and u) also consist of cell walls of B-component.

18. A product according to claim 17, characterized in that seen in a cross section of the filament, the extension of component A from said B-strand at face t to said B-strand at face u is interrupted by at least one more cell wall of B-component.

19. A product according to claim 11, characterized in that there are tw B-components B1 and B2, B1 forming the

boundary cell walls at faces r and s, and B2 forming at least a part of each bridge of B material between the said boundary cell walls.

20. A product according to claim 1, characterized in that B is based on fat or wax with additions for the taste, e.g. it consists of chocolate.

21. A product according to claim 1, characterized in that B is based on protein.

22. A product according to claim 1, characterized in that B is based on a polymer belonging to the group of carbohydrates or carbohydrate related compounds.

23. A product according to claim 1, characterized in that B is a gel reinforced with short fibres or platelets.

24. A product according to claim 2, characterized in that the boundary cell walls of B-component at faces r and s are molecularly oriented in their longitudinal direction.

25. A product according to claim 1, characterized in that A is a juice optionally in form of a soft gel, and that A contains dissolved sugar.

26. A product according to claim 1, characterized in that A is a juice optionally in form of a soft gel, and that A contains hydrolyzed proteins to give it taste and nutritional value comparable to meat.

27. A product according to claim 1, characterized in that A contains a pulp of short protein fibres.

28. A product according to claim 1, characterized in that A is a sour milk product.

29. A product according to claim 1, characterized in that A is marzipan.

30. A product according to claim 1, characterized in that A contains sintered particles of sugar or of hard caramel.

31. A product according to claim 1, characterized in that each platelet or lump of A mainly consists of seed or fractured nuts.

32. A product according to claim 1, characterized in that A is a paste based on meat.

33. A product according to claim 1, characterized in that the cell like spaces surrounded by B component contain air.

34. A bread or cake product according to claim 33, characterized in that A is based on swollen and baked starch and B is based on protein.

35. A product according to claim 14, characterized in that B is cheese.

36. A method of manufacturing +) ~~the product of claim 1~~, in which ~~foodstuff components~~ A and B, each in extrudable state, are formed into narrow flows and are extruded side-by-side in an array in mutualy interposed arrangement each through a separate chamber in a coextrusion die, said chambers terminating in a lineary or circular array of internal orifices, characterized in that subsequent to their exit from said internal orifices, the flows are devided into segments and joined to at least one segmental stream by means of a row comprising at least two dividing members, while the said array of internal orifics and the said row of dividing members reciprocate or rotate relative to each other to perform the dividing action, and the movements of the components are adapted to model the segments of B around

+) by coextrusion a food product of cell-like structure, in which one or more components (B) form the cell-walls, and one or more components (A) are contained in the cell-like spaces,

the segments of A to make B matrix material within the segmental str am, and that B is transformed to a firm materi l whereby at le st the final stage of this transformation takes place after finallization of the modelling.

37. A method according to claim 36, characterized in that the relative reciprocation or rotation is parallel to the line or circle which defines the beginning of the dividing members.

38. A method according to claim 36, characterized in that the die is a generally flat die for extrusion of sheet with the array of narrow flows parallel to the main surfaces of the sheet ("horizontal") and the narrow flows of B-component prior to the dividing being integral with at least one sheet-formed horizontal flow, and the dividing taking place by a generally vertical reciprocation.

39. A method according to claim 37, characterized in that when there are more than 2 such dividing members and extruded more than 1 segmental stream, 2 or more such streams are joined in a collection chamber at the end of the die as they leave the dividing members and are bonded together to a ribbon or sheet structure.

40. A method according to claim 37, characterized in that the modelling of the segments of B around the segments of A is established by expanding the width of the segmental stream as measured between adjacent dividing members and selecting the composition of A and B such that B is smeared out on the surfaces of the dividing members during this expansion while simultaneously any direct contact between A

and ~~partition~~ dividing member is liminated.

41) A method according to claim 37, characterized in that at least two components A and B are fed from separate extruders, pumps or other conventional feeding devices each through a conduit ending in an internal feeding slot communicating with each of the channels for the respective component to perform the side-by-side extrusion.

42. A method according to claim 41, characterized in that the conduits with feeding slots and the dividing members are installed in fixed dieparts, while the assembly of chambers for the side-by-side extrusion is reciprocating or rotating.

43. A method according to claim 41, characterized in that the conduits with feeding slots and the chambers for side-by-side extrusion are installed in a fixed diepart, while the dividing members are installed in a reciprocating or rotating diepart.

44. A method according to claim 39, characterized in that in addition to the relative reciprocation or rotation between the chambers for side-by-side extrusion and the dividing members, there is also established a relative reciprocation or rotation between the dividing members and the collection chamber at the end of the die.

45. A method according to claim 37, characterized in that the array of internal orifices are arranged in close proximity to or directly contacting the row of dividing members, whereby the dividing takes place by the shear between the said array and the said row.

46. A method according to claim 45, characterized in that

the dividing of each narrow flow to segments is performed by cutting action.

47. A method according to claim 46, characterized in that the cutting is performed by forming the upstream end of generally each dividing member as a knife at least on one side of the dividing member, the edge of the knife pointing generally in a direction parallel to the said relative reciprocation or rotation.

48. A method according to claim 46, characterized in that the cutting is performed by forming generally each of the internal orifices in the array as a knife at least on one side, the edge of the knife pointing generally in a direction parallel to the said relative reciprocation or rotation.

49. A method according to claim 46, characterized in combining the features of claim 47 and 48 to obtain the effect of a pair of scissors.

50. A method according to claim 47 or 48, in which the die is a flat die, characterized in that to enhance the effect of cutting, the array of orifices and the row of dividing member perform relatively fast and relatively small vibrations relative to each other in a direction generally perpendicular to a plane defined by the array and the segmental streams, these vibrations being in addition to the slower and bigger reciprocations along the direction defined by the line of orifices, whereby the knives perform sawing action.

51. A method according to claim 45, characterized in that the size of and the division between on one side the said

orifices and on the other side the said dividing members are adapted to make said members act as shutters which simultaneously open and simultaneously close the orifices for one and the same component.

52. A method according to claim 51, characterized in that at least component A is extruded in pulsations in a rythm syncronized with the relative reciprocation or rotation between the array of internal orifices and the row of dividing members to produce maximum driving force on the component while the orifices for the latter are open.

53. A method according to claim 52, characterized in that the pulsations are produced by a stamp or stamplike device for each narrow flow of the component, localized at the entrance to the chamber for the narrow flow and optionally extending into the said chamber.

54. A method according to claim 53, in which the stamp or stamplike device extends through the chamber, characterized in that it has a pattern of asymetrical grooves like the grooves of a file or protruding serrations like the serrations on a saw on at least a part of the surface or surfaces facing the flow, and that there are similar grooves or protruding serrations like the serrations on a saw on at least one wall of the chamber, the two patterns of grooves corresponding so that by a pawl-like effect the flow moves forward when the stamplike device is moved forward, and almost stands still when this device is moved backward.

55. A method according to claim 52, characterized in that in order to establish or facilitate the modelling of component B around the segment of component A streams of

component B are merged with each narrow flow of A before this meet its internal orifice, this merging being on both sides of A to form a composite ~~stream~~ flow of BAB configuration when the said composite stream is viewed in a section parallel to a plane defined by the array of narrow flows, and further that the internal orifices through which such composite BAB streams are extruded alternate with internal orifices through which plain B component is extruded, whereby immediately after the dividing the segmental streams will consist of BAB segments alternating with B segments.

56. A modification of the method according to claim 55, in which there are two B components B1 and B2 to become modelled together around each segment of A, and in which B1 is merged with A to form composite streams B1-A-B1 as defined in claim 55, characterized in that B1 in a similar manner is merged with B2 to form composite ~~streams~~ flow B1-B2-B1, and the internal orifices for the composite B1-A-B1 ~~streams~~ flows alternate with the internal orifices for the composite B1-B2-B1 ~~streams~~ flows whereby immediately after the dividing the segmental streams will consist of B1-A-B1 segments alternating with B1-B2-B1 segments.

57. A method according to claim 55, characterized in that the said merging is carried out in such a way that there is also formed a BAB configuration when the composite stream is viewed in a section which is perpendicular to the array of narrow streams and parallel to each of these streams and which goes through A, or optionally a configuration with a longer sequence of alternating B and A segments, B being at

the beginning and end of this sequence.

58. A method according to claim 45, characterized in that in the dividing process a layer of plein B-component is formed on each of those surfaces of the segmental streams, which are parallel to a plane defined by the row of dividing members, this forming established by making the internal orifices for the B-component extend beyond the orifices for the A component, whereby B-component extruded through the extruded parts of the orifices will be sheared out to form said layers.

59. A method according to claim 58, characterized in that in the dividing process there is also ~~injected~~ interposed one or more layers of B component into each segment of A component, by making each internal orifice for A interrupted at one or more locations without making the orifices for B component interrupted, whereby the shear will establish the ~~injection~~ interposing and formation of the layer or layers.

60. A method according to claim 36, characterized in that the transformation of B to a firm form takes place by cooling.

61. A method according to claim 36, characterized in that the said transformation of B takes place by gel formation.

62. A method according to claim 61, characterized in that the gel formation is established by heating.

63. A method according to claim 61, characterized in that prior to the coextrusion process B is formed as an extrudable material by disruption of a continous, firm gelstructure, and after the end of the coextrusion the continous firm structure of this gel is reestablished by

heating followed by cooling, or if the gel is adequately tixotropic, spontaneously or upon storage.

64. A method according to claim 61, characterized in that the gel formation is carried out by chemical reaction.

65. A method according to claim 61, characterized in that when the gel formation can be made sufficiently slow, the reactants are mixed prior to the coextrusion process.

66. A method according to claim 61, characterized in that the gel formation is established by admixture of a reactant to the A-component, this reactant gradually migrating into the B component when the components have been brought together in the coextrusion die.

67. A method according to claim 61, characterized in that the transformation to a firm form is enhanced by precipitation in the B-component of an inorganic salt, e.g. calciumphosphate, formed by reaction between ions in the A-component and ions in the B-component.

68. A modification of the process according to claim 64, characterized in that by a chemical reaction preformed solid particles are coagulated to continous firm material.

69. A method according to claim 36, characterized in that during the extrusion B is mainly in the form of a firm material in particle form dispersed in water, and after the end of the extrusion at least a part of the particles are first fused and then ~~solidified~~ transformed by cooling to make the material cohesive.

70. A method according to claim 61, characterized in that when there are two B components B1 and B2 and they are coextruded in the combinations claimed in claim 56, then B2

is formed into a gel at least in part while it proceeds as narrow flow towards the dividing process.

71. A method according to claim 36, in which A is based on water, characterized in that in order to operate the extrusion process with A in viscous plastic, or semisolid to solid state but achieve a more flowable consistency of A in the final product, a major portion at least of the water in A is frozen to ice prior to the extrusion, and the ice is melted after finallization of the extrusion process.

72. A method according to claim 36, characterized in that in order to operate the extrusion process with A in viscous plastic, or semisolid to solid state but achieve a more flowable consistency of A in the final product, A is applied to the extrusion process in a semisolid to solid state based on the contents in A of a polymer, and this polymer is depolymerized at least in part after finallization of the extrusion process.

73. A method according to claim 72, characterized in that the depolymerization process is enzymatic.

74. A method according to claim 36, in which A in the final state is wanted in fragil solid state, characterized in that A is fed to the extrusion process as a water soluble powder , e.g. a carbohydrate with addition of small amounts of water, and the powder is thermally sintered by help of the water after the dividing process.

75. A method of carrying out extrusion of any extrudable material in which the extrusion die comprises at least one narrow conduit for the material close to the exit of the die and conventional means to feed the material into the

conduit, characterized in that in addition to these conventionally feeding means, the xtrusio i die comprises a stamp or stamplike device localized at th entrance to said chamber and optionally extending through the said chamber, and operating in vibration, whereby said vibrations in conjunction with the conventional feeding means forward the material through the chamber in pulsating manner.

76. A method according to claim 75, in which the stamp or stamplike device extends through the chamber, characterized in that it has a pattern of asymmetrical grooves like the grooves of a file or protruding serrations like the serrations on a saw on at least a part of the surface or surfaces facing the flow, and that there are similar grooves on at least one wall of the chamber or on a corresponding stamplike device, the two patterns of grooves corresponding so that by a pawl-like effect the flow moves forward when one stamplike device is moved forward, and almost stands still when this device is moved backward or that it simultaneously is moved forward by such corresponding stamplike device.

77. A method of manufacturing a confectionery product of attractive optical appearance by coextruding at least two extrudable confectionery components of different optical characteristics, characterized in that said components each in extrudable state, are formed into narrow flows and are extruded side-by-side in an array in mutualy interposed arrangement each through a separate chamber in a coextrusion di , said chambers terminating in a lineary or circular

array of internal orifices, and that subsequent to their exit from said int rnal orifices, the flows ar devided into s gments and joined to t least one segmental stream by means of a row comprising at least two dividing members, while the said array of internal orifice ard the said row of dividing members reciprocate or rotate relative to each other to perform the dividing action, and if two or more such segmental streams are extruded they are optionally joined side-by-side, whereupon the extruded product is transformed to a firm state and optionally cleaved to clearly expose the pattern of the segmental stream or streams.

78. A method according to claim 77, characterized in that by the friction between each segmental stream and the dividing members, the segments are dragged out to obtain a head-tail form with a length from head to tail at least twice the width of the segmental stream.

FIG.1a x-x

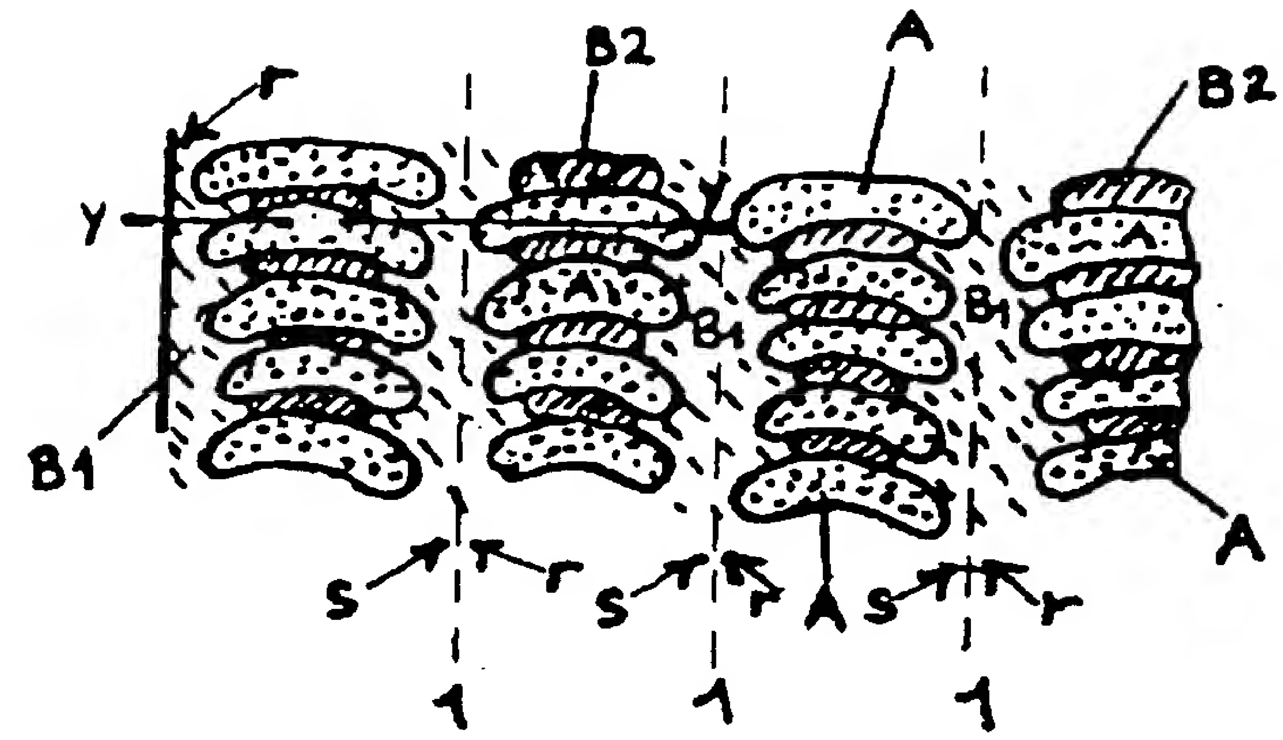


FIG.1b y-y

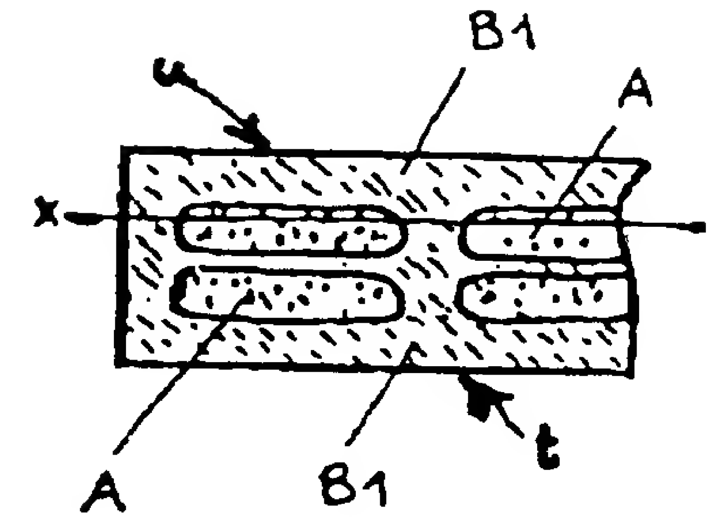
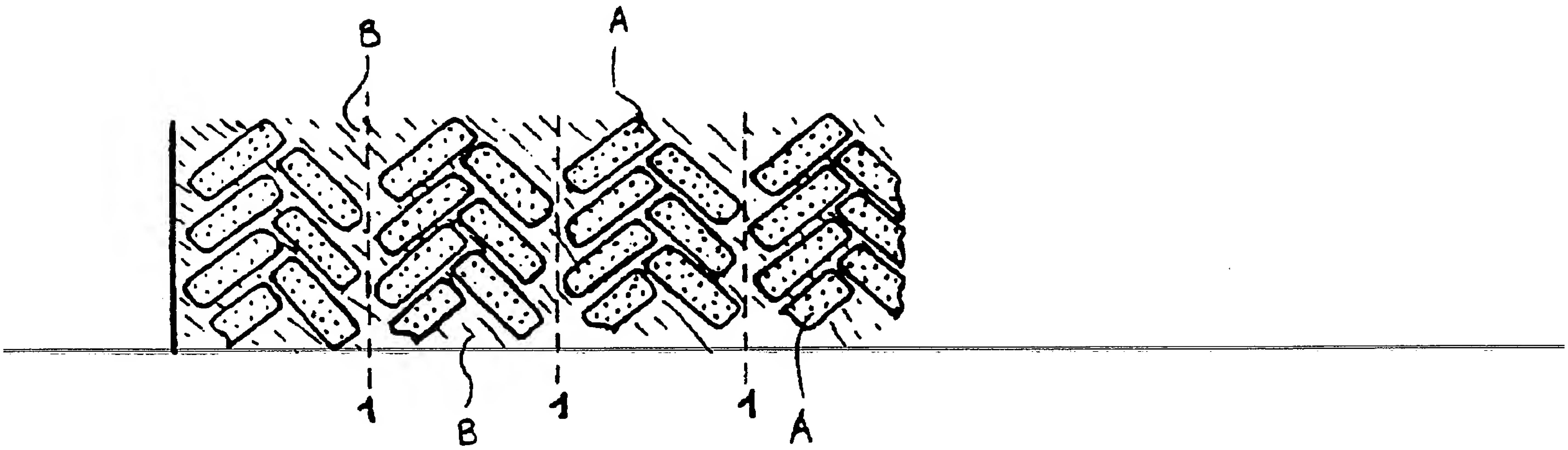


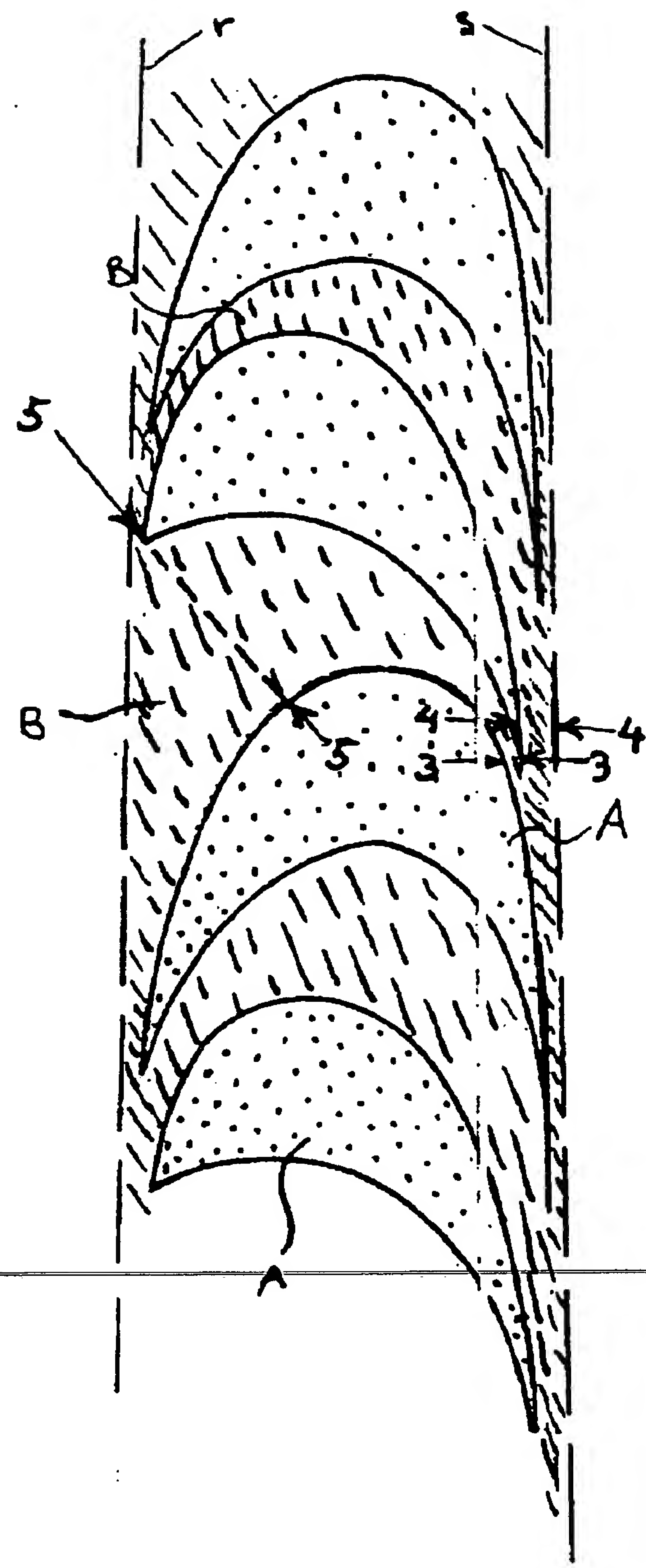
Fig.2



00·30·4L M

M 4.06.00

Fig. 3



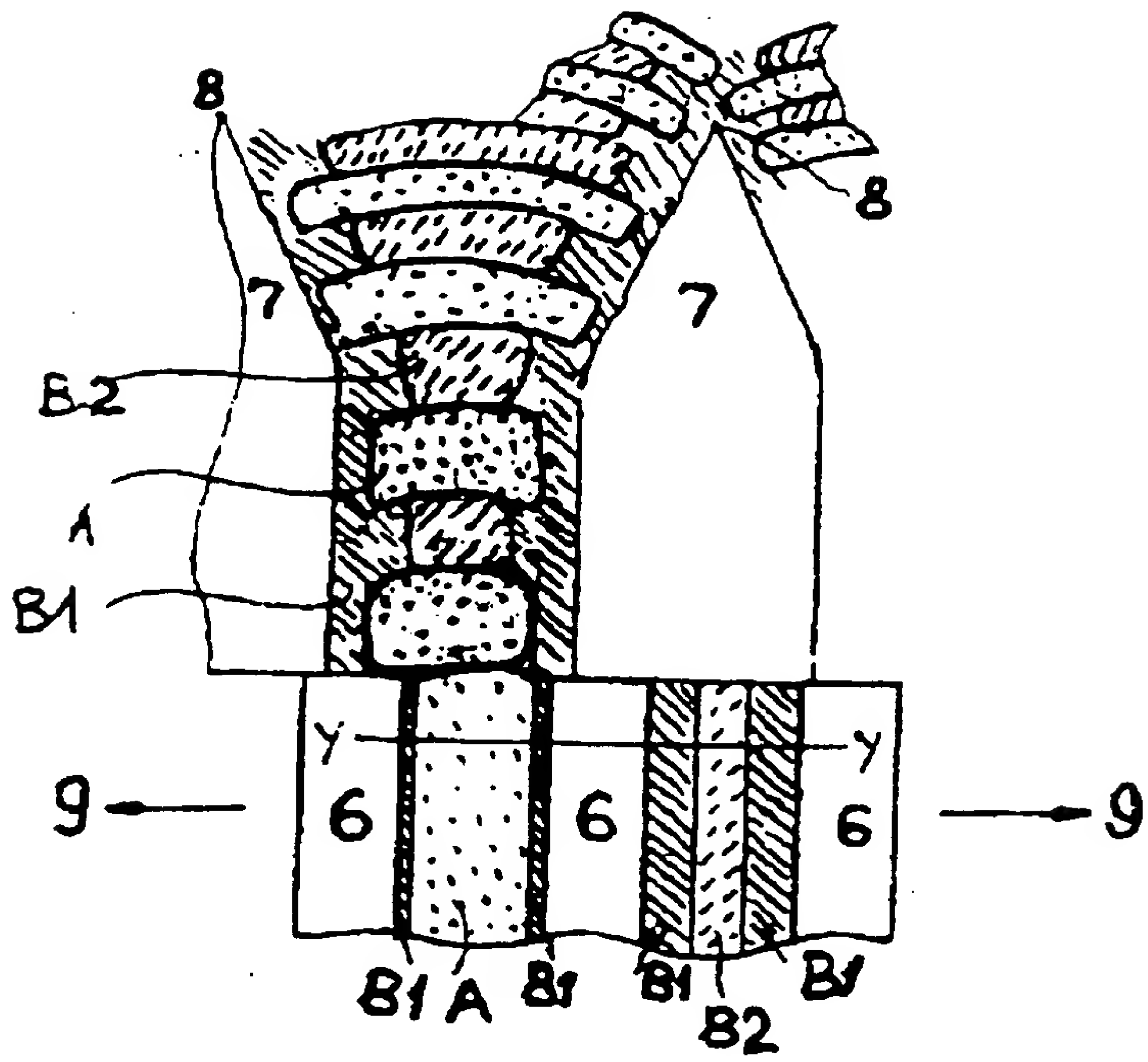


Fig. 4a
x - x

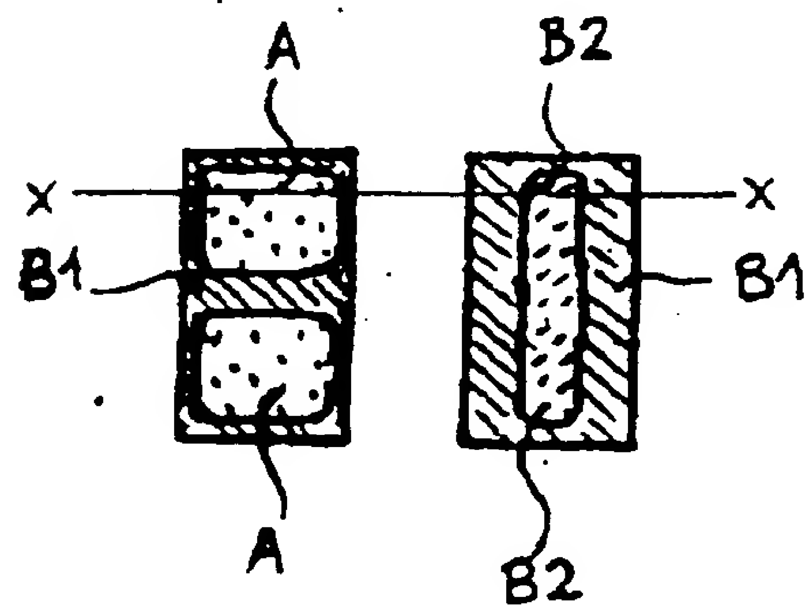


Fig. 4b
y - y

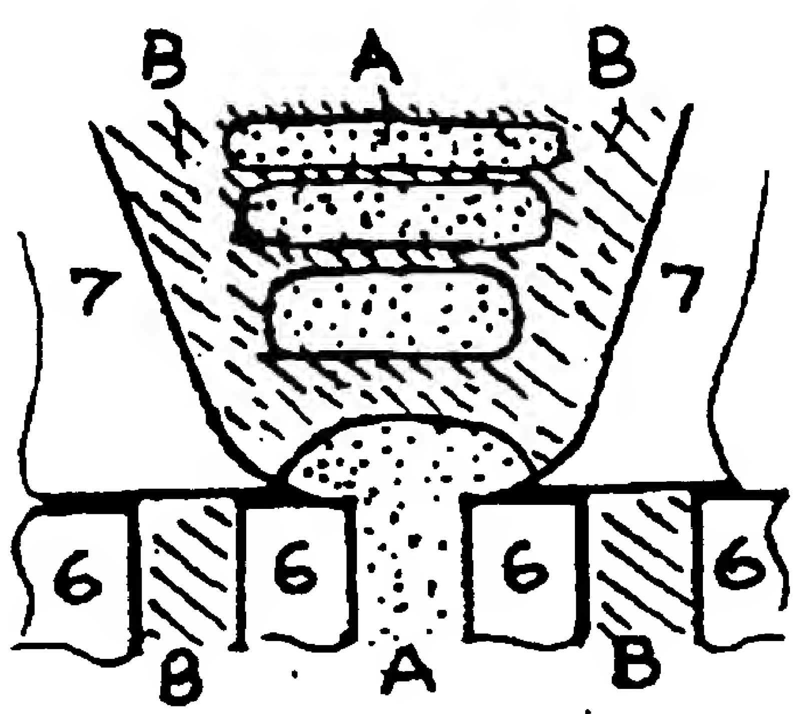


Fig. 5

11.06.00

Fig. 6a
x-x

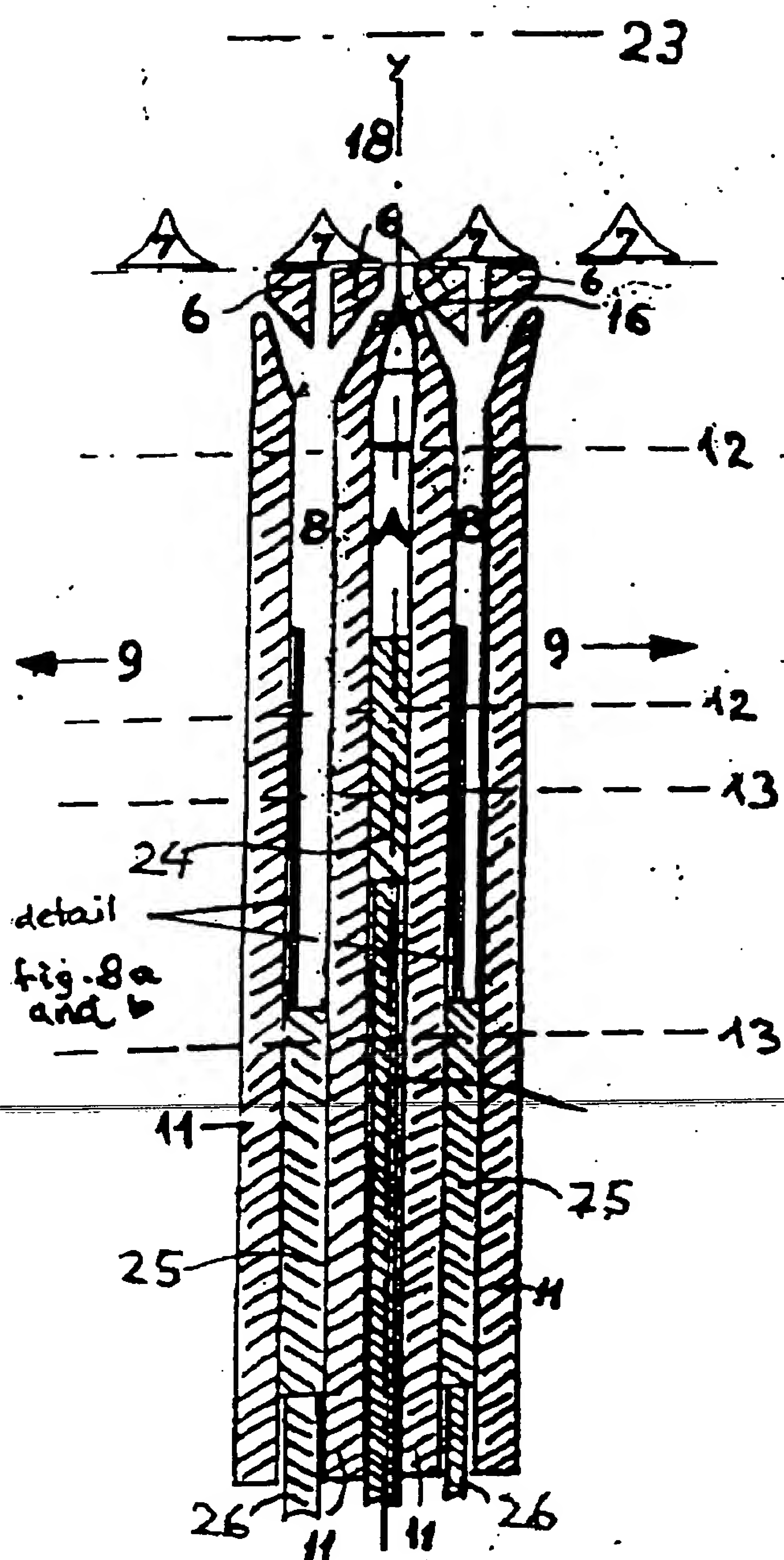


Fig. 6b
y-y

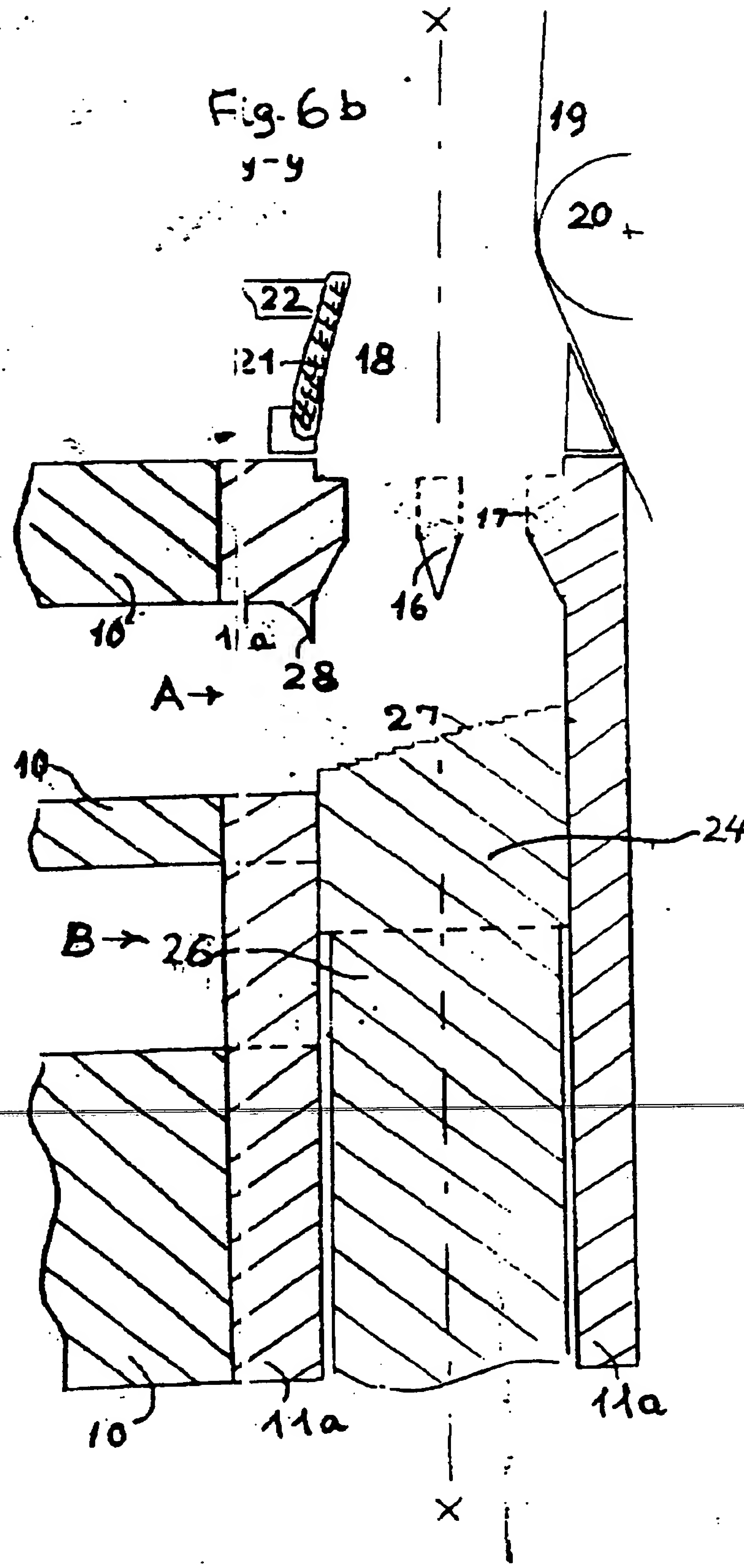


Fig. 7a

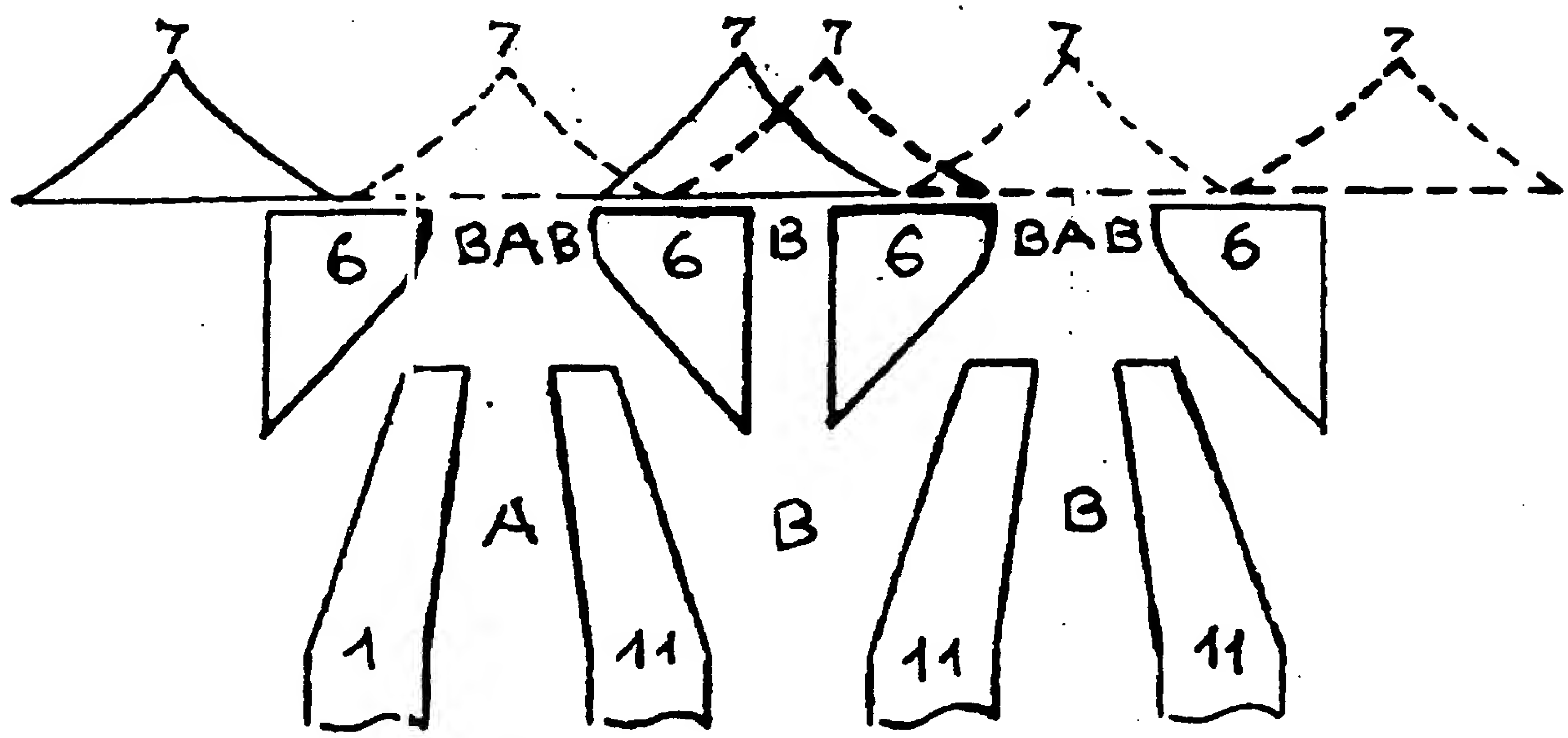


Fig. 7b

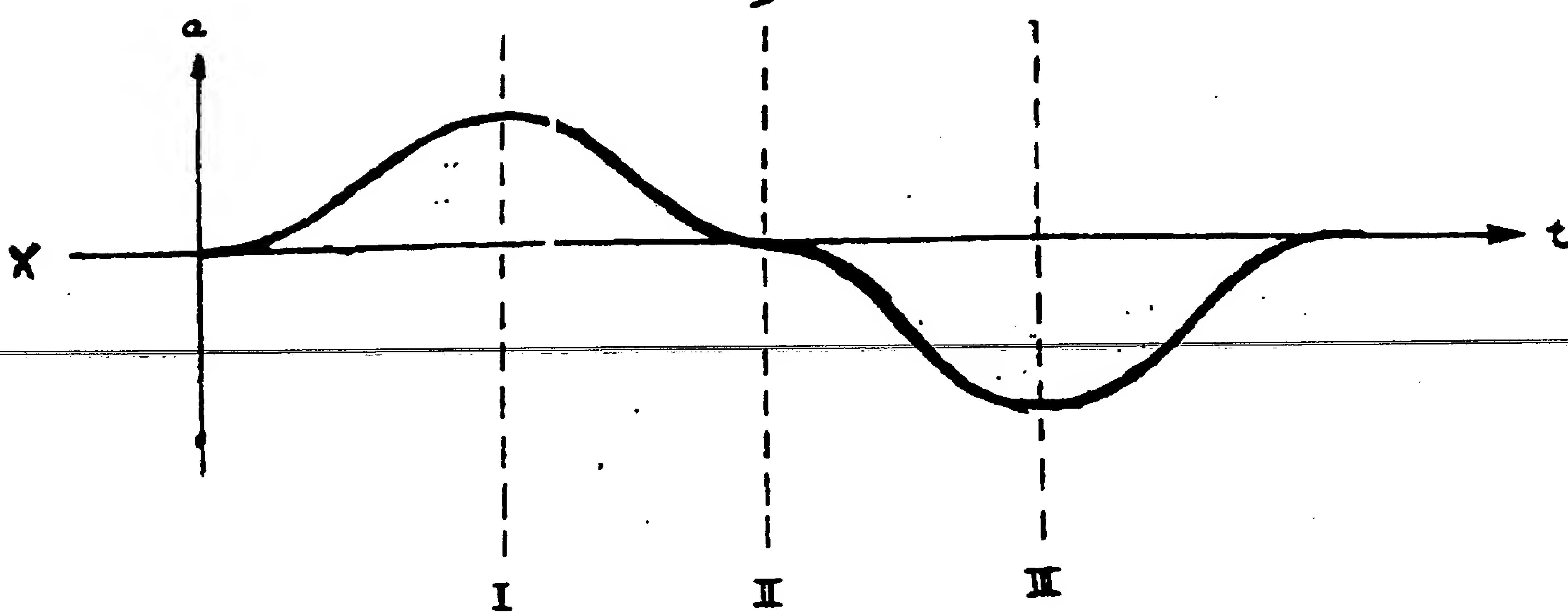


Fig 8a

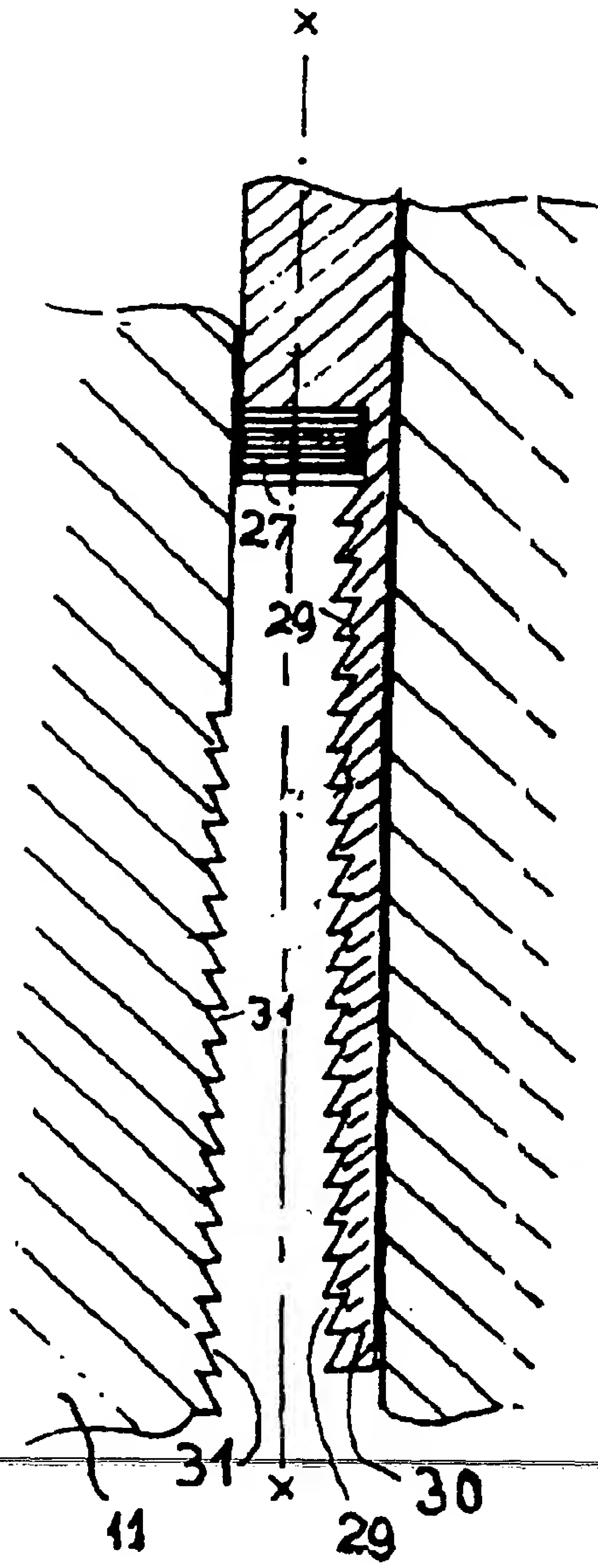


Fig. 8b

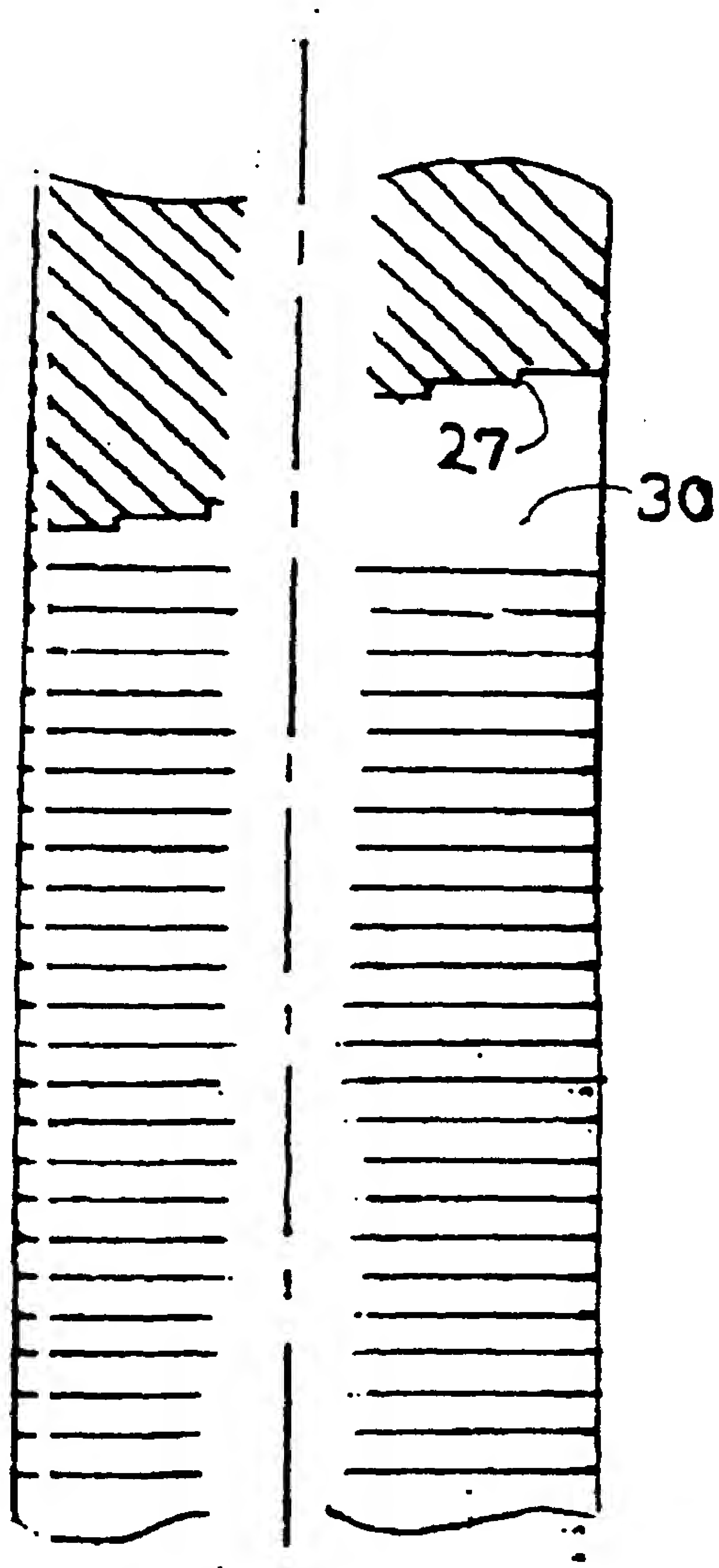
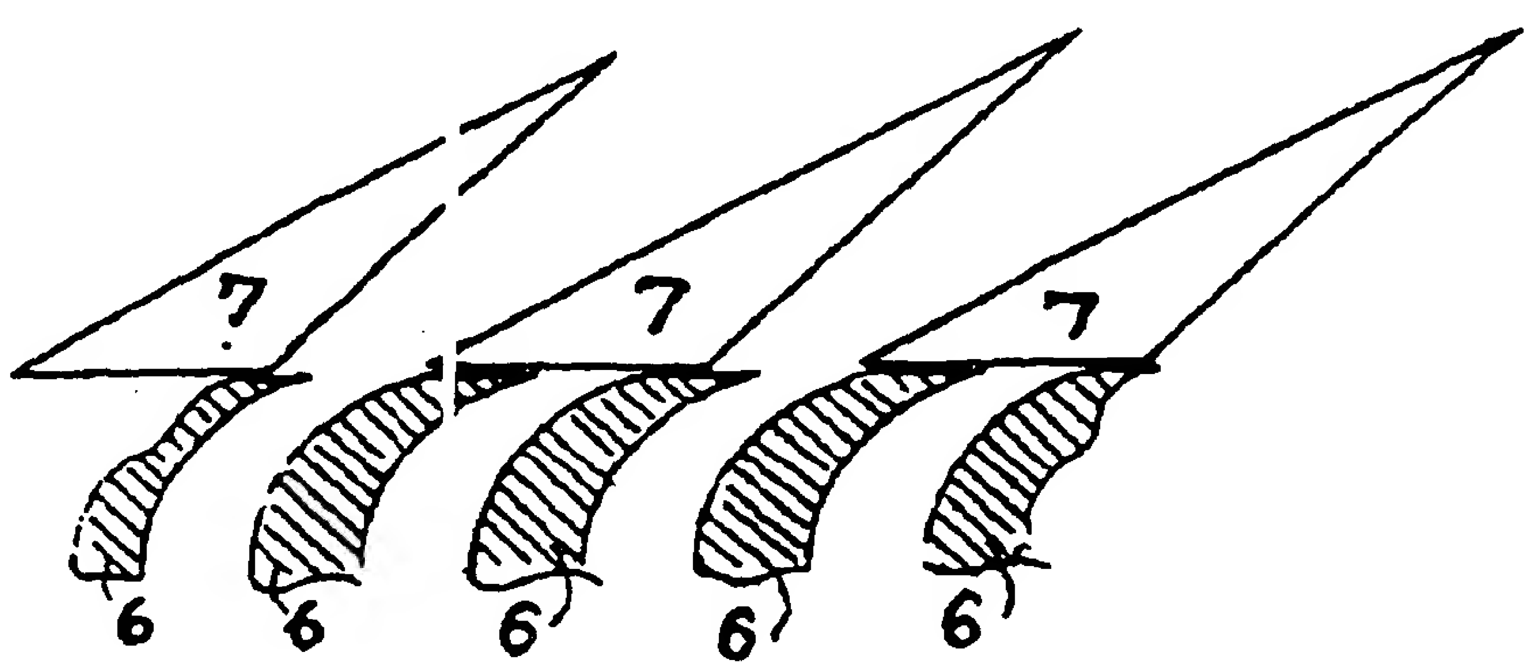


Fig. 9



00·30·[illegible] M

Fig. 10

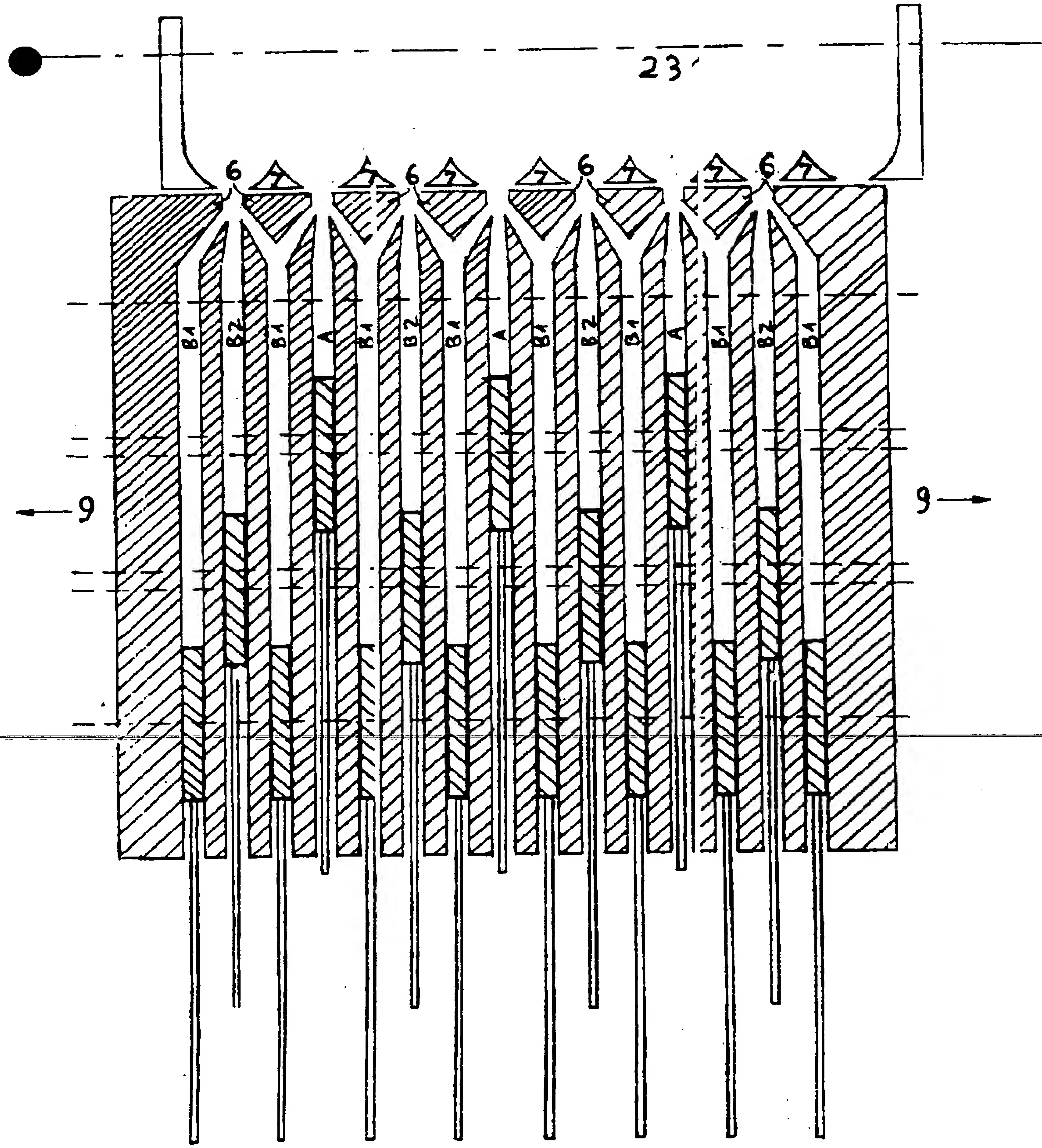


Fig 11a

Fig 11b